

1.0 INTRODUCTION

The Morning Star Mine (MSM) is located on the eastern slopes of the Ivanpah Mountains within the Mojave National Preserve (MNP) in southern California. MSM operated as an underground gold mine in the 1930's. After a period of inactivity, the site was again active in the late 1970's. It converted to an open pit operation in mid-1980. From 1984 to 1990, gold ore was processed on site using heap leach pads (CCJM, 1996). The site is approximately 75 miles southwest of Las Vegas, Nevada, ten miles west of Ivanpah, and 12 miles west of Nipton, California (Fig. 1). The mine property consists of a claim block of unpatented mining claims, the Star 1, 2, 3, 4, 5, 6, 7, 12, 13, 14, 15, and Johnson 1 and 2 claims.

Main features of the abandoned mine site are the open pit, waste rock piles, two heap leach pads, and a pregnant solution containment pond. Other features include various access roads and buildings, above ground fuel and chemical storage tanks, monitoring wells, groundwater supply wells, and remnants of the cyanide treatment system (Fig. 2). Dispersed recreation is the primary land use of the area surrounding the mine site.

1.1 Operational History

Precious metals at the Morning Star Mine were discovered in 1907. After a period of intermittent mining, Haliburton Oil acquired the property in the 1930s and conducted extensive underground exploration and development activities. In 1942, the War Production Board forced closure of the mine. Vanderbilt Gold Corporation (VGC), after acquiring the property and associated mineral leases, began full-scale underground development of the mine in 1979. The work was undertaken through a subsidiary, Heavy Metals Development Corporation. Extracted ore was hauled off-site for milling until the mine was converted into an open pit, cyanide heap leach operation in 1985. After construction of a lined heap leach pad (Pad No. 1), both crushed and run-of-mine ore were placed on the pad and sprinkled with a dilute sodium cyanide solution to leach gold and silver from the ore. The solution filtered through the heap material, was captured by the collection system, then gravity drained to a lined pregnant solution pond (PSP). The solution was then pumped back to the process plant where gold was separated from the "pregnant" solution. Two on-site wells provided process water for the leaching operation. Pumping the wells also kept the pit de-watered.

In 1987 the operation expanded and a two-stage crushing plant was brought on line. During 1988, two new fresh water wells were drilled in the Ivanpah Valley after the mine experienced a shortage of process water. A second leach pad, Pad No.2, was constructed in 1989. This pad included a modified solution storage and collection system integrated into the bottom of the Pad. Process solution applied to Pad No. 2 filtered through the ore to a collection system, but was pumped directly back to the process plant from an internal sump. There is no drain system in place at Pad No. 2 to allow solution to gravity flow from the pad. The leach solution spray system implemented on Pad No. 1 was changed to a drip irrigation system on Pad No. 2 to reduce evaporative losses. Toward the end of 1989, cyanide application to Pad No. 1 ceased and detoxification efforts began.

Falling metal prices in 1990 restricted continued development of the mine. At the same time, precious metal recovery also declined due to the mining of lower grade ores. Crushing operations ceased late in 1990 and no mining or milling has occurred since. Cyanide application to Pad No. 2 ceased in 1991. Detoxification efforts continued as solution from both pads was re-circulated through the precious metals recovery system. The process, which caused a breakdown of residual cyanide, resulted in reduced cyanide levels. By late 1993, Pad No. 1 was reported by VGC to have "...attained the detoxification thresholds required in its permit..." and a closure plan was submitted for the pad and PSP. In 1994, mine modifications were requested in a Plan of Operations report from VGC that would renew mining operations and alter the method of leaching (all ore processing and detoxification processes would be enclosed in a building). The CEO of VGC passed away in 1995 and no further work on any plan of operations was undertaken or proposed by VGC.

The mine, which became inactive before detoxification efforts were completed, was left with process solution in both pads and the PSP. Over time, the addition of meteoric water to the solution inventory exceeded the containment capacity of Pad No. 2. The liner overtopped at the south and east corners of the pad, resulting in a discharge of process solution to the environment. The discharge also caused erosion to the side slopes of the pad, which had the potential to cause the loss of structural integrity and a catastrophic release of solution. In addition, solution has continued to drain from Pad No. 1 into the PSP. Perennial inputs of solution, which vary with seasonal precipitation, were usually offset by evaporation from the PSP. However, the condition of the PSP liner continued to deteriorate over time.

1.2 Regulatory History

The MSM is located in the jurisdiction of the State of California, Regional Water Quality Control Board – Lahontan Region, Victorville Branch Office (LRWQCB). At the time the mine was initially permitted, it was within the administrative area of the Bureau of Land Management, Needles District. The Mojave National Preserve was created in October 1994 when Congress passed the California Desert Protection Act. Administration of the mine site passed from the Bureau of Land Management to the National Park Service (NPS). Mining is not prohibited on lands administered by the NPS, but is subject to rigorous environmental standards to control the impact on the Preserve and protect resources. Valid mining claims and the rights established by federal mining laws remain in effect.

In March 1998 the LRWQCB issued a Cease and Desist Order to the Vanderbilt Gold Corporation, the owner of the inactive mine. Vanderbilt had failed to meet the discharge specifications and provisions contained in the Waste Discharge Requirements (WDRs) previously established by the Board for the mine. The discharge specifications included detoxification of residual cyanide solution within 120 days of discontinuance of application of solution to ore. Surface discharge was prohibited. Permit provisions included directions to update the preliminary closure and post closure maintenance plan, instructions for submitting a final closure plan, and ordered that financial assurances be provided to ensure closure activities and post closure maintenance were continued after abandonment. Vanderbilt was also required to provide provisions to continue monitoring surface water, the vadose zone, and ground water; maintain proper grading and drainage features on Pad No. 1; and provide financial assurances based on approved detailed cost estimates to complete the work. The Order went on to describe violations of WDRs by Vanderbilt. The Park Service was also named by the LRWQCB as a responsible party for the discharge as administrator of the public land where the mine was located.

Limited site inspections and sampling were conducted on behalf of the Park Service in December 1998 and February 1999. Cyanide levels in exceedance of LRWQCB limits and/or the California Maximum Contaminant Levels (MCLs) were reported from the:

- Pad No. 1 discharge pipe;
- PSP and its leak detection system;
- Leachate collection system and leak detection system from Pad 2; and

- Two locations on Pad No. 2 where leakage was occurring.

A Cleanup and Abatement Order (CAO) was issued to Vanderbilt and the Mojave National Preserve by the LRWQCB in November 1999. Waste Discharge Requirements referenced in the CAO stated that for detoxification to be considered complete, the residual cyanide in the leach pads and PSP could not exceed 1.0 milligrams per liter (mg/l) for total cyanide and 0.2 mg/l for weak acid dissociable (WAD) cyanide. The limits for solids were: soluble Total Cyanide - 2.5 mg/kg, soluble WAD Cyanide - 0.5 mg/kg, Total CN after extraction of soluble WAD and Total CN - 10.0 mg/kg.

The CAO ordered the dischargers to:

- Submit evidence that activities to detoxify the leach pads and surface impoundment have been implemented in a manner that will achieve the soil constituent levels for cyanide by May 1, 2001.
- Submit a certified Final Closure and Post-closure Maintenance Plan that provides for:
 - Containment of residual constituents remaining in pad No. 1 and the PSP;
 - Continued monitoring of surface water, vadose zone and ground water; and
 - Maintenance of grading and drainage features for Pad No. 1.
- Provide a Closure and Post Closure Cost Estimate of the cost of hiring a third party to close and monitor the facility. The estimate must:
 - Be certified for accuracy;
 - Establish an estimate for all associated costs; and
 - Enable the Board to assess the reasonableness of the cost estimate.

If Vanderbilt failed to complete these items, the CAO stated the Park Service would become primarily responsible to complete the required work. To date, these items are incomplete.

The National Park Service undertook the preparation of an Engineering Evaluation and Cost Analysis (EE/CA) to analyze remediation and closure measure alternatives to address the two heap leach pads and PSP, compliance issues itemized in the CAO.

1.3 Engineering Evaluation and Cost Analysis

Harding ESE, a MACTEC Company, has been retained by the Park Service to prepare a streamlined EE/CA, examining remediation and closure method alternatives for the two heap leach pads and the PSP. The EE/CA reflects the directions outlined in *Guidance on Conducting Non-Time-Critical Removal Actions under CERCLA, U.S. Environmental Protection Agency*. The document states, "The EE/CA is a flexible document tailored to the scope, goals, and objectives of the non-time critical removal action. It should contain only those data necessary to support the selection of a response alternative, and rely upon existing documentation whenever possible". The term Removal Action is generic to this site; the final action may include on-site closure or clean closure alternatives.

This streamlined EE/CA was specifically designed to evaluate engineered alternatives to address the release of process solution to the environment. The release of solution is due to excess inventory in Pad No.2 (Pad No.2 does not drain and overtops if not pumped). There is also a risk for release of solution due to excess inventory in Pad No.1 and the PSP (Pad No.1 gravity drains to the PSP, the pond can potentially overtop if not pumped). Therefore, the EE/CA, and subsequent closure alternatives only address the two heap leach pads and the PSP. However, this document does outline and discuss other site features for the purposes of compiling all existing site information and in anticipation of future actions at the facility. For example, Alternative 3a (Section 10.3) discusses the use of the pit as a repository. Complete scope, goals, and objectives of the EE/CA are detailed in Section 8.0.

Because solution containment at Morning Star had already been compromised, measures to halt the release of cyanide-bearing solution to the environment were designed and implemented in 2002 (Section 9.0). The Interim Measures stopped the loss of solution by overtopping of the liner at Pad No. 2, took remedial action on erosion features that had developed on the pad containment berms, and reduced the potential for leakage from the PSP by relining the facility.

The Interim Measures will provide temporary site stabilization by stopping the release of solution until a final remediation and closure action is implemented. The Park Service in consultation with the Regional Water Quality Control Board and the U.S. EPA will choose a preferred alternative for final closure of the two heap leach pads and PSP at the completion of the streamlined EE/CA

process. Site activities will then shift from management of the solution inventory to final remediation and closure.